

1 **II. AMENDMENTS TO THE CLAIMS**

2 1.(Currently amended)A method of determining characteristics of samples comprising:

- 3 a. building algorithms of the relationship between sample characteristics and
4 absorbed and scattered light from a sample having an interior;
5 b. illuminating the interior of a sample with a frequency spectrum;
6 c. detecting the spectrum of absorbed and scattered light from the sample;
7 d. analyzing the detected spectrum of absorbed and scattered light from the sample with
8 the algorithms; calculating the characteristics of the sample.

9 2.(Currently amended)The method of claim 1 further comprising:

- 10 a. building the algorithms to generate a regression vector that relates the a VIS
11 and NIR spectra to brix, firmness, acidity, density, pH, color and external and internal
12 defects and disorders;
13 b. storing the regression vector, in a CPU having a memory, as a prediction or
14 classification calibration algorithm;
15 c. illuminating the sample interior with a spectrum of 250 to 1150nm;
16 d. inputting the detected spectrum of absorbed and scattered light from the
17 sample interior to a spectrometer;
18 e. converting the detected spectrum from analog to digital and inputting the
19 converted spectrum to a CPU; combining the spectrum detected;
20 f. comparing the combined spectrum with a stored calibration algorithm;
21 g. predicting the characteristics of the sample.

22 3.(Original) The method of claim 1 further comprising:

- 23 a. the characteristics are chemical characteristics including acidity, pH and sugar
24 content

25 4.(Original)The method of claim 1 further comprising:

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Application No. 09/804,613

Floyd E. Ivey, USPTO 35552,

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1 a. the characteristics are physical characteristics including firmness, density,
2 color, appearance and internal and external defects and disorders.

3 5.(Original) The method of claim 1 further comprising:

4 a. the characteristics are consumer characteristics.

5 6.(Currently amended)The method of claim 1 further comprising:

6 a. sampling is of samples from the group of C-H, N-H or O-H chemical groups;

7 b. illuminating of the interior of the sample is with a frequency spectrum
8 including visible and near infrared light;

9 c. building algorithms for the a correlation analysis separately of Brix, firmness,
10 pH and acidity in relation to the light spectrum output from the illuminated sample;

11 d. detecting the spectrum of absorbed and scattered light from the sample with a
12 light detector.

13 7.(Currently amended)The method of claim 2 further comprising:

14 a. illuminating of the interior of the sample with a frequency spectrum of 250 to
15 1150 nm;

16 b. detecting the spectrum of absorbed and scattered light from the sample with at
17 least one light detector; the at least one light detector comprising at least one light
18 detector fiber; shielding the at least one light detector fiber from the illuminating
19 spectrum;

20 c. measuring the spectrum for chlorophyll at around 680 nm;

21 d. correlating the characteristics of Brix, firmness, pH and acidity with the
22 measured spectrum.

23 8. (Currently amended) An apparatus to predict characteristics of a sample
24 performing the method of claim 1 comprising:

25 a. at least one light source; a sample having an sample surface and an interior;

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1 input mechanism of positioning the at least one light source proximal the sample surface;

2 b. at least one light detector; output mechanism of positioning the at least one
3 light detector proximal the sample surface;

4 c. at least one mechanism of measuring the illumination detected from the
5 sample.

6 9.(Currently amended and Previously Amended Preliminary to Office Action) The
7 apparatus of claim 8 further comprising:

8 a. the at least one ~~illumination~~ light source produces a spectrum within the range
9 of 250 to 1150 nm;

10 b. the at least one mechanism of measuring the illumination is a spectrometer; the
11 spectrometer has at least one input;

12 c. the at least one light detector is a light pickup fiber; the at least one light
13 detector collects a spectrum which is received by the at least one spectrometer input;

14 the spectrometer has at least one spectrometer output channel; a CPU having at
15 least one CPU input; the at least one CPU input receiving the at least one spectrometer
16 output; at least one computer program; the CPU is controlled by the at least one computer
17 program; the CPU having at least one CPU output; the at least one computer program
18 causing the at least one CPU output to perform the steps of 1) calculation of absorbance
19 spectra (173) occurs for each at least one spectrometer output channel 1...n, 2) combine
20 absorbance spectra (174) into a single spectrum encompassing the entire wavelength
21 range detected from the sample by spectrometers 1...n (170), 3) mathematical
22 preprocessing or preprocess (175), e.g. by smoothing or box car smooth or calculate
23 derivatives, precedes 4) the prediction or predict (176), for each at least one spectrometer
24 output channel, comparing the preprocessed combined spectra (175) with at least one
25 stored calibration spectrum or at least one calibration algorithm(s) (177) for each sample

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1 characteristic 1...x (178), ~~e.g. comprising~~ brix, firmness, acidity, density, pH, color and
2 external and internal defects and disorders, for which the sample is examined, followed
3 by 5) decisions or further combinations and comparisons of the results of quantification
4 of each characteristic, 1...x, ~~e.g. comprising~~ determination of internal and or external
5 defects of disorders (179), (180); determination of color (181); determination of indexes
6 ~~such as~~ of eating quality index 182, appearance quality index (183) and concluding with
7 sorting or other decisions (184); 6) sorting or other decisions (184) may be input process
8 controllers to control packing/sorting lines or may determine the time to harvest, time to
9 remove from cold storage, and time to ship;

10 d. the sample is from the chemical group of C-H, N-O, and O-H.

11
12 ~~10. 9A:~~ (Currently Amended) The apparatus of claim 9 further comprising:

13 a. the at least one spectrometer output are converted from analog to digital by at least
14 one A/D converter which become. for each at least one spectrometer output channel, input to at
15 least one CPU input; the at least one CPU output provided for each at least one spectrometer
16 output channel 1...n..

17
18 ~~11. 40:~~ (Currently Amended) The apparatus of claim 8 further comprising:

19 a. the least one ~~illumination~~ light source is a is a tungsten halogen lamp; the illumination
20 is transmitted to the sample surface by fiber optics;

21 b. the at least one light detector is a fiber optics light pickup;

22 c. the at least one spectrometer comprises a 1026 linear array detector;

23
24 ~~12. 41:~~ (Currently amended) The apparatus of claim 9 further comprising:

25 a. the at least one light ~~illumination~~ source is at least one ~~an~~ illumination fiber.

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1 13. 12.(Currently amended)The apparatus of claim ~~10~~ 8 further comprising:

2 a. the ~~an~~ at least one ~~illumination~~ light source comprises a plurality of illumination

3 fibers;

4 b. the plurality of illumination fibers are arrayed such that each illumination fiber is

5 equidistant from adjoining illumination fibers; the at least one light detector is positioned

6 centrally in the array of illumination fibers.

7

8 14. 13.(Currently amended) The apparatus of claim ~~11~~ 12 further comprising:

9 a. the at least one light source is a ~~the~~ plurality of illumination fibers ~~are~~ comprised of

10 32 illumination fibers.

11

12 15. 14.(Currently amended) The apparatus of claim ~~11~~ 9 further comprising:

13 a. the at least one ~~illumination~~ light source is a 5w tungsten halogen lamp.

14

15 16. 15.(Currently amended) The apparatus of claim ~~11~~ 9 further comprising:

16 a. the at least one illumination light sources is ~~the~~ plurality of illumination sources is

17 comprised of two 50 w light sources;

18 b. the at least one light detector is comprised of a plurality of light detectors.

19

20 17. 16.(Currently amended) The apparatus of claim 15 further comprising:

21 a. the at least one illumination light source is a ~~the~~ plurality of light detectors ~~are~~

22 arrayed such that each light detector is equidistant from adjoining light detectors.

23

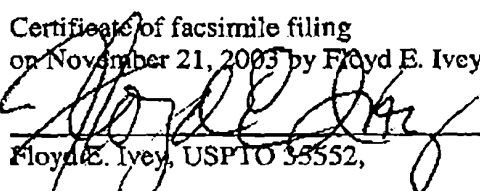
24 18. 17.(Currently amended) The apparatus of claim ~~16~~ 15 further comprising:

25 a. the at least one light detector is a ~~the~~ plurality of light detectors comprising twenty-

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1 two light detectors.

2

3 ~~19. 18:~~(Currently amended) The apparatus of claim ~~12~~ 11 further comprising:

4 a. the at least one illumination light source comprised of an ellipsoidal reflector with
5 having a 50 w bulb with cooling fan; the at least one light source is a the plurality of illumination
6 fibers is comprised of at least one fiber optic fiber for transmission of the light source to the
7 sample surface.

8 b. the at least one fiber optic and the at least one light detector spring biased against the
9 sample surface; the pressure exerted by the spring biasing limited by the character of the sample.

10

11 ~~20. 19:~~(Currently amended) The apparatus of claim ~~10-11~~ further comprising:

12 a. the at least one illumination light source is a 5 w tungsten halogen lamp; the at least
13 one light detector is a single fiber optic fiber; the illumination light source is positioned against
14 the sample surface 180 degrees distal to the detection fiber.

15

16 ~~21. 20:~~(Currently amended) The apparatus of claim ~~12-11~~ further comprising:

17 a. a polarization filter is positioned between the at least one illumination light source
18 and the sample;

19 b. a matching polarization filter is positioned between the at least one light detector and
20 the sample.

21

22 ~~22. 21:~~(Currently amended) The apparatus of claim ~~19- 21~~ further comprising:

23 a. the polarization filter is a linear polarization filter; the matching polarization filter is a
24 linear polarization filter rotated 90 degrees in relation to the polarization filter.

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1 23. 22:(Currently amended)An apparatus to predict characteristics of a sample

2 performing the method of claim 1 comprising:

3 a. at least one light source; a sample having an sample surface and an interior;
4 input mechanism of positioning the at least one light source proximal the sample surface;
5 at least one shutter intermediate the at least one light source and the sample; the at least
6 one light source having a lamp output;

7 b. at least one light detector; output mechanism of positioning the at least one
8 light detector proximal the sample surface; at least one collimating lens intermediate the
9 at least one light detector and the sample surface; at least one mechanism of measuring
10 the illumination detected from the sample surface;

11 c. at least one reference light detector directed to the lamp output; at least one
12 shutter intermediate the at least one reference light detector and the at least one lamp
13 output; at least one mechanism of measuring the illumination detected from the lamp
14 output.

16 24. 23:(Currently amended) The method of claim 2 further comprising:

17 a. using the predicted characteristics of the sample in combination as follows: using the ratio of
18 the sugar content to acid content to better predict eating quality, taste, sweet/sour ratio; using the
19 combined data from two or more of the following: sugar content, acid content, pH, firmness,
20 color, external and internal disorders to better predict eating quality.

22 25. 24:(Currently amended) The method of claim 2 further comprising:

23 a. sensing sample data including sensing by sample presence sensing means the presence or
24 absence of a sample conveyed on a sample conveyor while in motion; sensing by sample position
25 sensing means the position/location of the sample 30 relative to the point of spectrum

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1 measurement; presence sensing means and position sensing means having outputs to a computer
2 program controlled CPU; the computer program controlled CPU determining if the sample 30
3 being measured is at the optimal location(s) for spectrum measurement; the computer program
4 controlled CPU determining if a sample is present.

5
6 ~~26. 24A~~ (Currently amended) The method of claim ~~25 24~~ further comprising:

7 a. presence sensing means is a proximity sensing means.

8
9 ~~27. 24B~~ (Currently amended) The method of claim ~~26 24A~~ further comprising:

10 a. position sensing means is an encoder or pulse generator (330) detecting sample conveyor
11 (295) movement and providing one or more electronic or digital signals to a CPU (172) which
12 initiates, by computer program control, control signals to initiate and stop acquisition of spectra.

13
14 ~~28. 24C~~ (Currently amended) The method of claim ~~27 24B~~ further comprising:

15 a. determining by computer program controlled CPU timing for performing reference testing of
16 light source lamp, spectrometer performing of reference testing of light source lamps and of
17 spectrometer receiving spectra input from detectors.

18
19 ~~29. 24D~~ (Currently amended) The method of claim ~~28 24C~~ further comprising:

20 a. testing of reference including measurement of dark spectra and/or reference spectra and/or
21 standard/calibration samples.

22
23 ~~30. 24E~~ (Currently amended) The method of claim ~~29 24D~~ further comprising:

24 a. light source lamp light collection achieved using a collimating lens (78) and or other light
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1 transmission means including ~~for example~~ fiber-optics to transfer the light that has interacted
2 with the sample (30) to the spectrometer(s) (170) detectors (200). ~~if~~ if no sample (30) is present.
3 other reference measurements are made to improve stability and accuracy such as previously
4 mentioned dark spectra, reference spectra (lamp intensity and color output), and
5 standard/calibration samples, which may be optical filters or polymers or organic material with
6 known and repeatable spectral characteristics. ~~Measurements~~ measurements that are made when no sample
7 is present include, but are not limited to 1) measuring a reference spectrum (intensity vs.
8 wavelength) of the light source(s), 2) measuring the dark current (no light conditions) of one or
9 more spectrometer(s) (170) detector(s) (200), including but not limited to the sample
10 spectrometer(s) (170) and the reference spectrometer(s) (170), and 3) standard or calibration
11 samples or filters (130) or material.

12
13 31.25-(Currently amended) The apparatus of claim 8 further comprising:

14 a. sample presence sensing means for sensing of the presence or absence of a sample conveyed
15 on a sample conveyor while in motion; sample position sensing means of the position/location of
16 the sample (30) relative to the point of spectrum measurement; presence sensing means and
17 position sensing means having outputs to a computer program controlled CPU; the computer
18 program controlled CPU determining if the sample (30) being measured is at the optimal
19 location(s) for spectrum measurement; the computer program controlled CPU determining if a
20 sample is present.

21
22 32.25A-(Currently amended) The apparatus of claim 31.25 further comprising:

23 a. presence sensing means is a proximity sensing means.
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1 33. 25B-(Currently amended) The apparatus of claim 32. 25A further comprising:
2 a. position sensing means is an encoder or pulse generator (330) detecting sample conveyor
3 (295) movement and providing one or more electronic or digital signals to a CPU (172) which
4 initiates, by computer program control, control signals to initiate and stop acquisition of spectra.

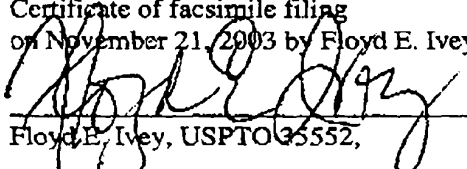
5
6 34. 25C-(Currently amended) The apparatus of claim 33. 25B further comprising:
7 a. computer program controlled CPU timing for performing reference testing of light source
8 lamp, spectrometer performing of reference testing of light source lamps and of spectrometer
9 receiving spectra input from detectors.

10
11 35. 25D-(Currently amended) The apparatus of claim 34. 25C further comprising:
12 a. reference testing including measurement of dark spectra and/or reference spectra and/or
13 standard/calibration samples.

14
15 36. 25E-(Currently amended) The apparatus of claim 35. 25D further comprising:
16 a. light source lamp light collection achieved using a collimating lens (78) and or other light
17 transmission means including ~~for example~~ fiber-optics to transfer the light that has interacted
18 with the sample (30) to the spectrometer(s) (170) detectors (200)-~~if~~ if no sample (30) is present,
19 other reference measurements are made to improve stability and accuracy such as previously
20 mentioned dark spectra, reference spectra (lamp intensity and color output), and
21 standard/calibration samples, which may be optical filters or polymers or organic material with
22 known and repeatable spectral characteristics-~~M~~ measurements that are made when no sample is
23 present include, but are not limited to 1) measuring a reference spectrum (intensity vs.
24 wavelength) of the light source(s), 2) measuring the dark current (no light conditions) of one or
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1 more spectrometer(s) (170) detector(s) (200), including but not limited to the sample
2 spectrometer(s) (170) and the reference spectrometer(s) (170), and 3) standard or calibration
3 samples or filters (130) or material.

5 ~~37-26~~-(Currently amended) The method of claim 2 further comprising:

6 a. measuring by reference measurement changes in light source lamp intensity or color output, a
7 reference spectrometer output and output of spectrometer receiving sample spectra input from
8 detectors; transmitting light from light source lamps to the reference spectrometer with detector
9 using a reference light transmission means.

11 ~~38-26A~~-(Currently amended)The method of claim ~~37-26~~ further comprising:

12 a. using fiber-optics as the reference light transmission means.

14 ~~39-26B~~-(Currently amended) The method of claim ~~37-26~~ further comprising:

15 a. using a light pipe as the reference light transmission means.

17 ~~40-26C~~-(Currently amended) The method of claim ~~37-26~~ further comprising:

18 a. positioning the reference light transmission means, at the light source lamp, to allow only
19 light from the light source lamp to enter the reference light transmission means.

21 ~~41-26D~~-(Currently amended) The method of claim ~~40-26C~~ further comprising:

22 a. placing at least one light shutter intermediate each light source lamp and each reference light
23 transmission means; opening and closing the at least one light shutter by shutter control means.

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1 ~~42.-26E:~~ (Currently amended) The method of claim ~~37-26~~ further comprising:

2 a. measuring, by the reference spectrometer, each light source lamp separately; inputting the
3 reference spectrometer output to the computer controlled CPU; storing in the CPU intensity vs.
4 wavelength spectrum profile for each light source lamp; comparing the stored intensity vs.
5 wavelength spectrum with the reference spectrometer output; determining from the comparison
6 the condition of the light source lamp.

8 ~~43.-26F:~~ (Currently amended) The method of claim 2 further comprising:

9 a. using the detected spectrum as a reference spectrum, for purposes of calculating an
10 absorbance (or log 1/R) spectrum, which is linear with concentration (~~e.g., percent Brix or~~
11 ~~acidity or pounds of firmness, etc.~~).

13 ~~44.-26G:~~ (Currently amended) The method of claim ~~41-26D~~ further comprising:

14 a. closing all of the light shutters of the reference light transmission means; allowing a dark
15 current (no light condition) measurement of the spectrometer (170) detector(s) (200); measuring
16 the dark current and its intensity value at each wavelength (or detector) pixel; subtracting the
17 measured dark current from a reference spectrum obtained with the shutters (330) open.

19 ~~45.-26H:~~ (Currently amended) The method of claim ~~37-26~~ further comprising:

20 a. measuring a reference spectrometer output and a sample spectrometer output dark
21 current; shielding by shielding means, the input to the reference spectrometer and the
22 input to the sample spectrometer; inputting the reference spectrometer output and the
23 sample spectrometer to the computer controlled CPU; subtracting the output measured
24 from the reference spectrometer; subtracting the output measured from the sample
25

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Floyd E. Ivey, USPTO 35552,

1 spectrometer.

3 ~~46-27~~ (Currently amended) The apparatus of claim 8 further comprising:

4 a. at least one light detector (80) having at least one output (82) to at least one
5 spectrometer (170) having at least one detector (200); at least one colluminating lens (78)
6 intermediate the at least one light detector (80) and a sample (30); the at least one light
7 detector (80) positioned to detect light from the sample (30); at least one light source
8 (120) lamp (123); a light shielding means intermediate the at least one light source (120)
9 lamp (123) and a sample (30); at least one aperture (310) in the light shielding means to
10 allow illumination of the sample (30) by the at least one light source (120) lamp (123); at
11 least one light interruption means intermediate the at least one light source (120) lamp
12 (123) and the at least one aperture (310); the at least one light interruption means operable
13 by at least one light interruption control means; the at least one light interruption control
14 means receiving control signals from at least one CPU (172) having at least one light
15 interruption operating control output; at least one reference light transmitting means
16 receiving reference light output from the at least one light source (120) lamp (123); at
17 least one reference light interruption means intermediate the at least one light source
18 (120) lamp (123) and the at least one reference light transmitting means; the at least one
19 reference light interruption means operable by at least one reference light interruption
20 means control means; the at least one reference light interruption means control means
21 (305) receiving control signals from at least one CPU (172) having at least one reference
22 light interruption operating control output (307); the at least one reference light
23 transmitting means (81) providing an input to the at least one spectrometer (170) detector
24 (200); the at least one CPU (172) providing at least one lamp power output (125) to the at
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Application No. 09/804,613

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1 least one light source (120) lamp (123); the at least one spectrometer (170), receiving
2 input from at least one reference light transmitting means (81) having at least one output
3 (82) received as in input to the at least one CPU (172); the spectrometer output (82)
4 capable of A/D conversion to form input to the at least one CPU (172); the at least one
5 spectrometer (170), receiving input from at least one detector output (82) received as in
6 input to the at least one CPU (172); the spectrometer output (82) capable of A/D
7 conversion to form input to the at least one CPU (172); mounting means to mount light
8 sources (120) lamps (123), detectors (80), light interruption means including shutters
9 (300), shutter control means (305), reference light transmitting means (81) and case
10 (250); encoder/pulse generator (330) input to CPU (172) providing sample conveyor
11 (295) movement data; computer program to operate CPU (172) in data collection and
12 control functions.

13
14 ~~47-28~~ (Currently amended) The method of ~~37-26~~ further comprising:

15 a. measuring, as a reference measurement, the light source (120) lamp(s) (123) intensity
16 vs. wavelength output using reflecting means (360); positioning reflecting means (360) to
17 reflect light from light source lamps to a light detector having a light detector output
18 which is received by a spectrometer detector.

19
20 ~~48-28A~~ (Currently amended) The method of ~~47-28~~ further comprising:

21 a. positioning the reflecting means, by reflection position means, to a position to reflect
22 light from light source lamps to a light detector as dictated by reflecting control means
23 (308), as an output from a CPU (172), controlling the reflection position means; the CPU
24 (172), via means, detecting the presence or absence of a sample (30) and, when a
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1 reference measurement is to be made, inserting the reflecting means as dictated by
2 reflecting control means (308) controlling the reflection position means as an output from
3 a computer program controlled CPU (172); withdrawing the reflecting means as dictated
4 by reflecting control means (308) controlling the reflection position means as an output
5 from a computer program controlled CPU (172).

6
7 ~~49. -29:~~ (Currently amended) The apparatus of claim 8 further comprising:

8 a. reflecting means, positioned by reflection position means, to a position to reflect light
9 from light source lamps to a light detector as dictated by reflecting control means (308),
10 as an output from a CPU (172), controlling the reflection position means; the CPU (172),
11 via means, detecting the presence or absence of a sample (30) and, when a reference
12 measurement is to be made, inserting the reflecting means as dictated by reflecting
13 control means (308) controlling the reflection position means as an output from a
14 computer program controlled CPU (172); withdrawing the reflecting means as dictated by
15 reflecting control means (308) controlling the reflection position means as an output
16 from a computer program controlled CPU (172).

17
18 ~~50. -30:~~ (Currently amended) The apparatus of claim 8 further comprising:

19 a. a light reflecting or diffusing body for obtaining the reference spectrum may also be
20 obtained by mechanical insertion of reference means (430), as seen in Fig. 12 and Fig. 13,
21 in or near the location where actual sample (30) is normally measured, which is between
22 the light source (120) lamp(s) (123) and reference light transmission means (320) leading
23 to the sample spectrometer (170) detector (200)(s); insertion is by insertion means
24 including but not limited to an actuator system (400) capable, upon receiving control
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1 signals or means as recognized by those of ordinary skill including control signals or
2 means provided from a CPU (172), of operation of an actuator (410) causing a piston
3 (420) to extend (421) and retract (422) as seen in Fig. 12 and 13; power, including for
4 example electrical, pneumatic, hydraulic and other means, is provided to operate the
5 actuator by power transmission means (440) as will be appreciated by those of ordinary
6 skill.

7
8 ~~51. 31.~~ (Currently amended) The method of claim 2 further comprising:

9 a. illuminating, with at least one light source lamp, the sample interior while the sample
10 is rolling or revolving, where a rolling measurement generally improving whole product
11 measurement.

12
13 ~~52. 32.~~ (Currently amended) The method of claim 2 further comprising:

14 a. illuminating, with at least one light source lamp, the sample interior while the sample
15 is not rolling or revolving, where a non-rolling measurement provides better accuracy and
16 introduces less spectral noise due to movement.

17
18 ~~53. 33.~~ (Currently amended) The method of claim 2 further comprising:

19 a. obtaining, as a sample (30) passes by the point of spectrum acquisition, multiple
20 spectra, where each spectrum representing a different measurement location or area on
21 the product.

22
23 ~~54. 34.~~ (Currently amended) The method of claim 2 further comprising:

24 a. optimizing signal-to-noise and accuracy with small and large samples by 1)
25

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Application No. 09/804,613

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1 determining the size or weight of the sample by weight or mass sensors common to the
2 industry; 2) utilizing a color sorter or defect sorter to provide data; e.g., from camera or
3 CCD images; 3) utilizing other size sensors based on magnetic, inductive, light
4 reflectance or multiple light beam curtains, common to other industries.

5
6 ~~55. -34A.~~(Currently amended) The method of claim ~~54-34~~ further comprising:

7 a. adjusting, in accordance with the relative size of the sample, the hardware spectrum
8 acquisition parameters or the amount of light; e.g., by varying an aperture (310) size, to
9 provide an improved signal-to-noise ratio spectrum for large samples (30) and/or to
10 prevent detector (80) saturation by light for small product sample (30); e.g., detector (80)
11 exposure or integration time can be set for longer time periods for large product samples
12 (30) and for shorter time periods for small product.

13
14 ~~56. -35.~~(Currently amended) The method of claim 2 further comprising:

15 a. improving accuracy by inspection of multiple individual spectra collected from a
16 single sample; removing poor quality or "outlier" spectra; calculating the absorbance
17 spectrum from the raw data collected for dark, reference and sample; inspecting each
18 individual spectrum from the series or batch of spectra acquired for each individual
19 product sample by a computer program controlled CPU or by programmed hardware;
20 deleting poor quality spectra from this batch of spectra, using the remaining spectra for
21 constituent or property prediction; combining the retained spectra of the product sample
22 with the appropriate reference and dark current measurements to produce an absorbance
23 spectrum as follows: absorbance spectrum = $-\log_{10} [(sample\ intensity\ spectrum - sample\ dark\ current\ spectrum) / (reference\ intensity\ spectrum - reference\ dark\ current\ spectrum)]$
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1 i.e. the absorbance spectrum is equal to the negative logarithm (base 10) of the ratio of
2 the dark current corrected sample spectrum to the dark current corrected reference
3 spectrum.

4
5 ~~57.-36:~~ (Currently amended) The method of claim ~~56-35~~ further comprising:

6 a. combining all of the absorbance spectra for each product sample to produce a mean or
7 average absorbance spectrum of the product sample; using this average absorbance
8 spectra to compute the sample component, characteristic or property of interest based on a
9 previously stored calibration algorithm.

10
11 ~~58.-37:~~ (Currently amended) The method of claim ~~56-35~~ further comprising:

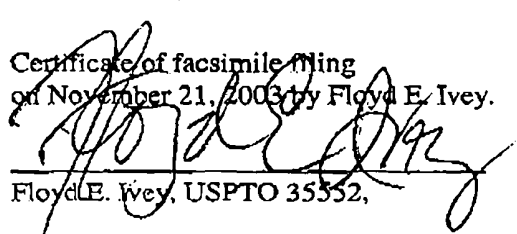
12 a. using each absorbance spectrum individually with the previously stored calibration
13 algorithm to compute multiple results of the sample component, characteristic or property
14 of interest for an individual product sample; determining the average or mean component,
15 characteristic or property of interest by summing all of the values and dividing the
16 resultant sum by the number of absorbance spectra used.

17
18 ~~59.-38:~~ (Currently amended) The method of claim 2 further comprising:

19 a. measuring samples and linking location on product sample where visible/NIR data was
20 collected with the same location that will be measured by the laboratory reference technique;
21 calibrating performed as follows: 1) measuring spectra of product sample (30) and measuring
22 absorbance spectra; correcting for reference and dark current and storing measurements; 2)
23 undertaking standard laboratory measurements on the product sample (30); observing that it is
24 important to the success of the NIR method that the portion of the sample (30) that is
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1 interrogated between the light source(s) (120) lamps (123) and light collection(s) detectors, e.g.,
2 light detectors (80), leading to the spectrometer(s) (170) detectors (200) is the same as that
3 portion measured by the standard laboratory technique.

4
5 ~~60. 38A.~~ (Currently amended) The method of claim ~~59-38~~ further comprising:

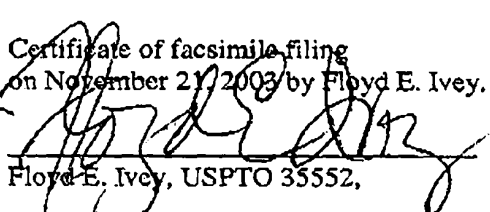
6 a. transporting samples, by a sample conveyors (295), to the NIR measurement location
7 including to a light detector; selecting rolling or not rolling sample conveyor (295) means; where
8 rolling analyzing the entire sample for the component, characteristic or property of interest;
9 averaging, if calibration algorithms are constructed in this way (using measurements of rolling
10 product), all of the retained spectra for that individual product to produce an average absorbance
11 spectrum and the total product component or property is assigned to this one absorbance
12 spectrum.

13
14 ~~61. 38B.~~ (Currently amended) The method of claim ~~59-38~~ further comprising:

15 a. transporting samples, by a sample conveyor (295), to the NIR measurement location including
16 to a light detector; selection not rolling sample conveyor (295) means; performing laboratory
17 measurements on the same portion of product sample (30) that spectra were taken from;
18 determining whether to separate a sample into smaller sub-portions prior to laboratory analysis;
19 adjusting the time period of NIR data acquisition to shorter or longer times, corresponding to the
20 measurement of smaller or larger product samples (30), respectively; associating, with each sub-
21 portion of the product sample (30), one or more spectra associated with that particular location;
22 assigning the laboratory determined component, characteristic or property of interest to each
23 spectrum or spectra from that particular location.

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1 ~~62-39~~. (Currently amended) The method of claim 2 further comprising:

2 A. performing mathematical processing on absorbance spectra prior to conducting
3 statistical correlation analysis and calibration model building; pre-processing absorbance
4 spectra using a bin and smooth function; relating by Partial least squares analysis (or
5 variants thereof such as piecewise direct standardization) the processed absorbance
6 spectrum to the assigned component and property values such as Brix, acidity, pH,
7 firmness, color, internal or external disorder severity and type, and eating quality.

8
9 ~~63-40~~. (Currently amended) The method of claim 2 further comprising:

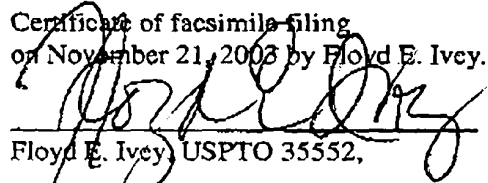
10 A. minimizing the number of samples needed to develop a calibration model; collecting
11 spectra on all test samples; performing, prior to destructive laboratory measurements,
12 principal components analysis (PCA) on the absorbance spectra; generating Resultant
13 Score plots from PCA (e.g., Score 1 vs. Score 2, Score 3 vs. Score 4, etc.); selecting a
14 subset of the original samples (e.g., 40% of the original number of samples) from the
15 Score plots in either a random fashion or by selecting samples that, as a group, yield a
16 similar range, mean and standard deviation of score values compared to the entire group
17 of original samples (30).

18
19 ~~64-41~~. (Currently amended) The method of claim ~~63-40~~ further comprising:

20 A. periodically requiring calibration updates to maintain measurement accuracy;
21 minimizing the efforts of calibration updates; analyzing, as fruit or vegetable samples are
22 in a packing and sorting warehouse, the visible/near infrared spectra; examining by
23 computer program controlled CPU, and determining if the sample qualifies as a potential
24 calibration update sample; selecting calibration update samples (30) which cover low to
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1 high component values and which have Score values that cover the same range as the
2 original sample's (30) Score values.
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